



Spray-coated CZTS Nanoparticles in Water for Environmentally-friendly, Inexpensive Solar Cell Absorber Material

Engberg, Sara; Mirbagheri, Naghmehalsadat; Crovetto, Andrea; Bosco, Edoardo; Hansen, Ole; Schou, Jørgen

Published in:
Book of Abstracts. DTU's Sustain Conference 2015

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Engberg, S., Mirbagheri, N., Crovetto, A., Bosco, E., Hansen, O., & Schou, J. (2015). Spray-coated CZTS Nanoparticles in Water for Environmentally-friendly, Inexpensive Solar Cell Absorber Material. In *Book of Abstracts. DTU's Sustain Conference 2015* [E-29] Technical University of Denmark.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Spray-coated CZTS Nanoparticles in Water for Environmentally-friendly, Inexpensive Solar Cell Absorber Material

Sara Engberg^{*1}, Naghmeh Mirbagheri¹, Andrea Crovetto², Edoardo Bosco², Ole Hansen², Jørgen Schou¹

1: DTU Fotonik; 2: DTU Nanotech

*Corresponding author email: sleen@fotonik.dtu.dk

The kesterite material, $\text{Cu}_2\text{ZnSnS}_4$ (CZTS), is very promising as absorber material in future thin film solar cells. The elements are abundant, the material has a high absorption coefficient, and it is non-toxic. These properties make CZTS a potential candidate also for large-scale applications. Here, solution processing allows for comparatively fast and inexpensive fabrication and the power conversion efficiency is also relatively high. The current challenges are, (1) that the nanoparticles do not sinter during annealing, and (2) that grain boundaries and defects are believed to be a site for recombination that limits the efficiency. Annealing in vacuum, nitrogen and/or a diluted hydrogen atmosphere facilitates grain growth and improves the electronic properties.

In this work, nanocrystals of CZTS with a targeted Cu-poor/Zn-rich composition are synthesized through a hot-injection method with diethylene glycol as the solvent, which makes them dispersible in water. The nanocrystal inks are deposited through spray coating, and annealed in a vacuum furnace using a graphite box with sulfur. The surface morphology and thus grain growth are studied for various annealing conditions.

The films are characterized with scanning electron microscopy (SEM), and an example before and after annealing is displayed in Fig. 1 (a) and (b), respectively. Compositional changes are monitored by energy dispersive X-ray spectroscopy (EDX) and the crystallinity by X-ray diffraction (XRD).

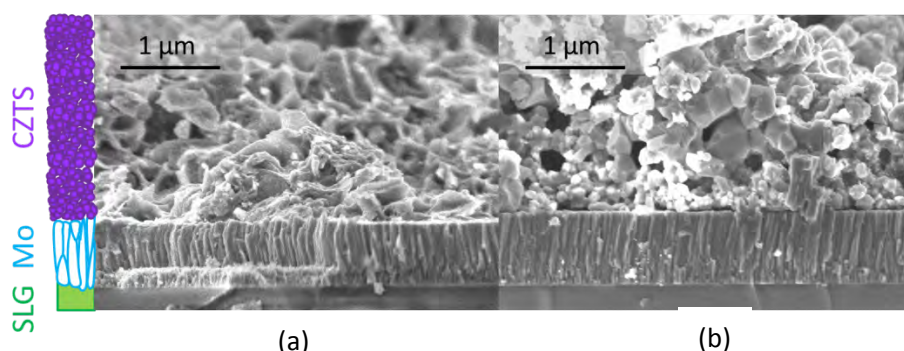


Fig. 1 SEM image of cross-section of spray-coated CZTS film after (a) pre-annealing at 200°C, and (b) annealing in nitrogen atmosphere at 550°C, where grain growth is visible.